Living shorelines in the Chesapeake: A habitat- and water quality-enhancing solution to shoreline erosion

Chesapeake Bay Trust

MARYLAND OUR BAY Treasure the Chesapeake

Definition of Living Shorelines

"Living shorelines" are defined as shoreline stabilization techniques that use *as many natural habitat elements as possible* to protect shorelines from erosion while also providing critical habitat for Bay wildlife.

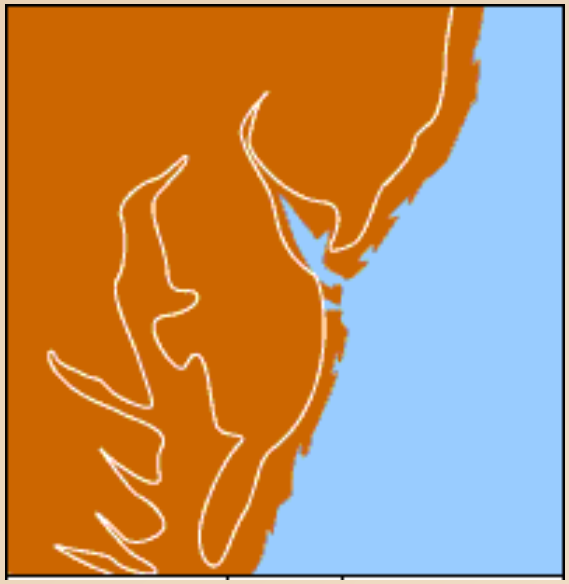
The “Problem:” Eroding Shorelines

33% of all Chesapeake Bay shorelines are actively eroding.

The “Problem:” Eroding Shorelines

Erosion is a natural process

7,000 years ago



present

10,000 years from now

Maps courtesy of UDel

The "Problem:" Eroding Shorelines

Erosion is a natural process.

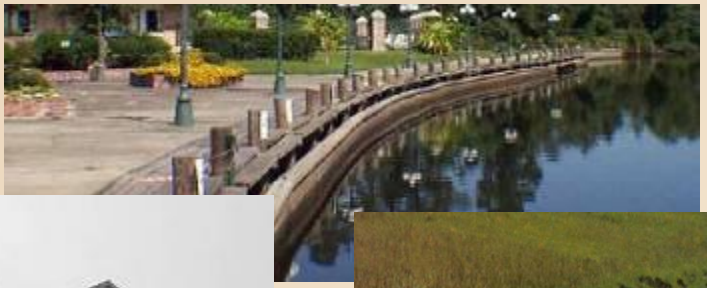
Human processes play a role.

Sea Level Rise: > 1 foot (40 cm) last century

Hardening of Shorelines

We're hardening our shorelines to protect against erosion

28-32% Maryland is armored
11-19% Virginia is armored



Hardening of Shorelines

But armor doesn't always work,
and people starting thinking it might not be so good for critters

History of “Living Shorelines”

- 1970s — Environmental Concern begins experimenting with purely non-structural approaches. Failures abound

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1972 – Ed Garbisch, Environmental Concern

Control of upland bank erosion through tidal marsh construction on restored shores: Application in the Maryland portion of Chesapeake Bay
EW Garbisch and JL Garbisch. 1994. Environmental Management18

Hambleton Island restoration: Environmental Concern's first wetland creation project.
EW Garbisch. 2005. Ecological Engineering 24

History of “Living Shorelines”

- 1970s Environmental Concern begins experimenting
- 1980s “Living shorelines” term coined in MD; hybrid concept developed

Types of Living Shoreline Projects/Designs

Living Shorelines

Structural practices

low structure ◄——————————————————————————► high structure

Non-structural living shorelines:
natural habitat elements only: vegetation, oyster reef, coarse woody debris, sand.

Hybrid living shorelines:
include natural habitat elements, as well as some hard structures such as stone sills or breakwaters

practices without a natural habitat component:
- Bulkheads/Seawalls
- Revetments
- Breakwaters
- Groins/jetties

Non-structural living shoreline

Low-structure hybrid living shoreline

Medium-structure hybrid living shoreline

Structural erosion control practice

Non-Structural

BEFORE

AFTER

Hidden Pond,
Crownsville, MD

Low Structural

BEFORE

AFTER

St. Johns College, Annapolis, MD

Hybrid Living Shorelines

Segmented Sill Design

Continuous Sill With Windows

window/tidal gate

Hybrid Living Shorelines

Chesapeake Maritime Museum, Miles River

High Energy/High Structure

Chesapeake Bay Ecology Center, Grasonville, MD

Asbury Retirement Home, Calvert County

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- early 2000s Delaware puts “no bulkhead” policy in place

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● 2006	Chesapeake Living Shoreline Summit held
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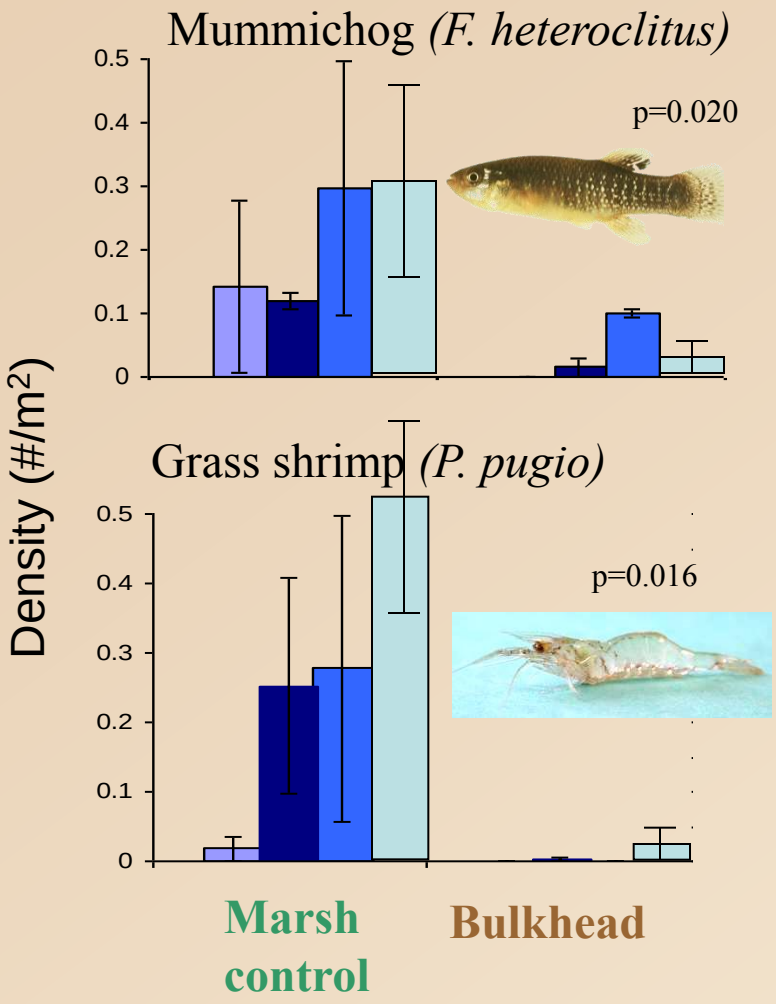
Folks start asking: Are we sure these things "work?"

Ecological: Armor vs. Natural Marsh

Most species more abundant in marsh than armor



Chain pickerel

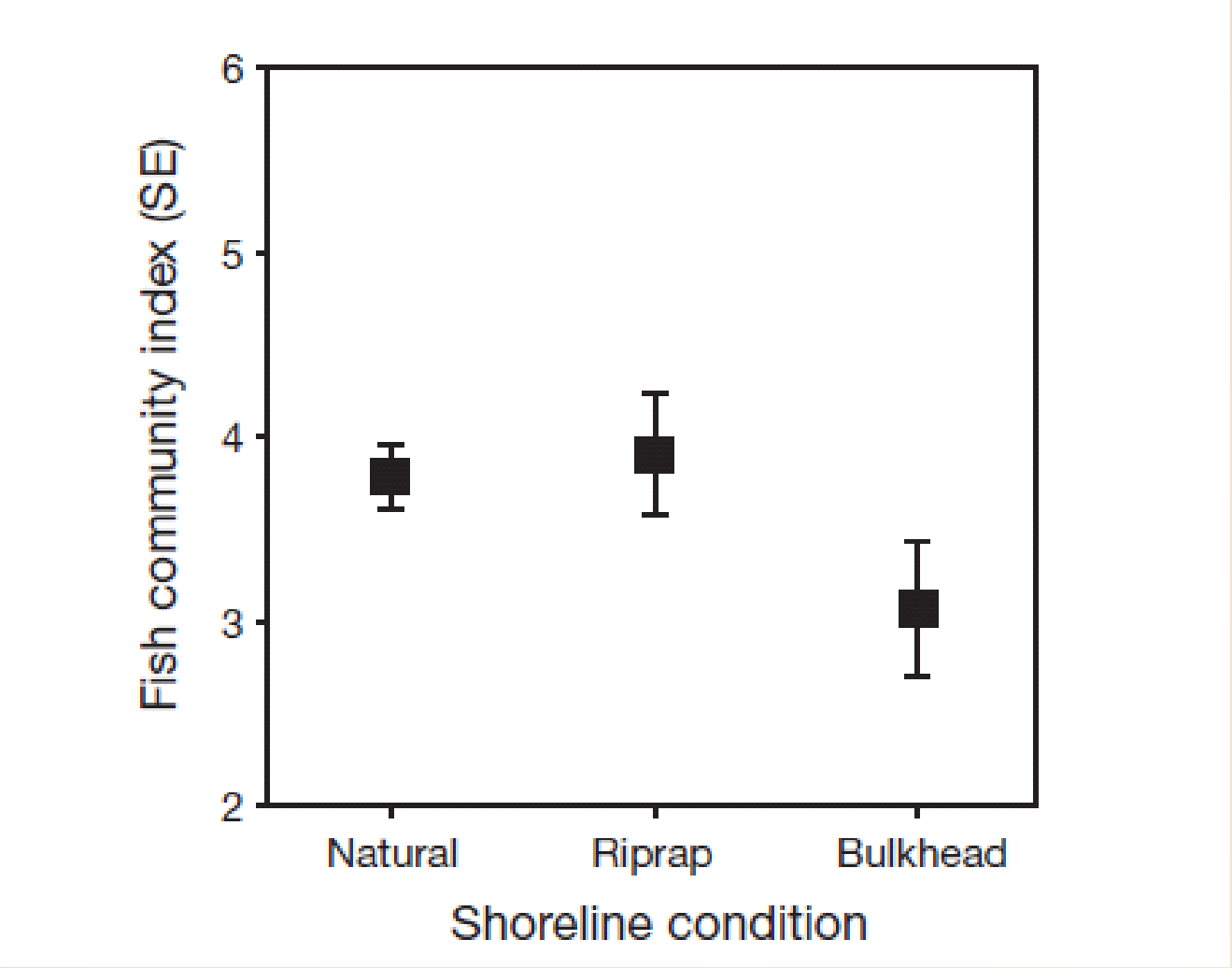
Stickleback

Spot

West River College Creek Miles River Beards Creek

Ecological: Armor vs. Natural Marsh

Bulkhead lower values of diversity, density (Bilkovic and Roggero 2008)



Ecological: Armor vs. Natural Marsh

Seawalls - lower values of spp richness (Brauns et al. 2005; German lakes)

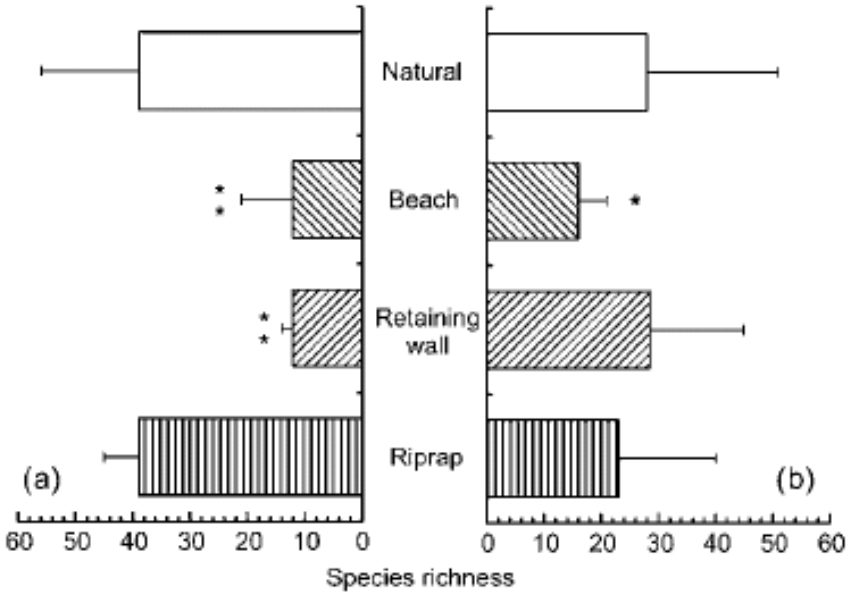
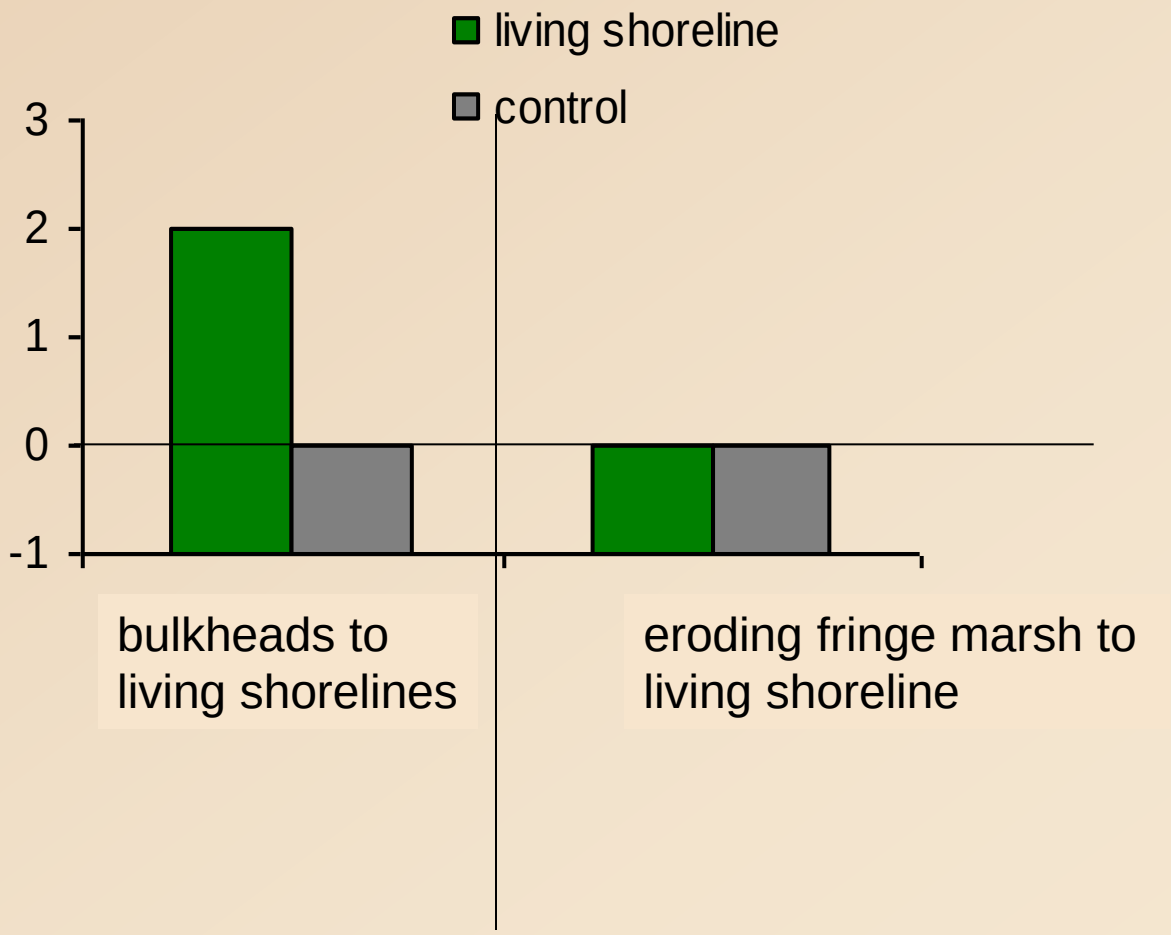


Fig. 2. Median species richness (+ max) of natural and developed shorelines (beach, retaining wall, riprap) within the (a) eulittoral and (b) infralittoral zones. Significant differences (Mann–Whitney *U*-test) between natural and each type of developed shorelines are indicated by asterisks (**$P < 0{\cdot}01$, *$P < 0{\cdot}05$).

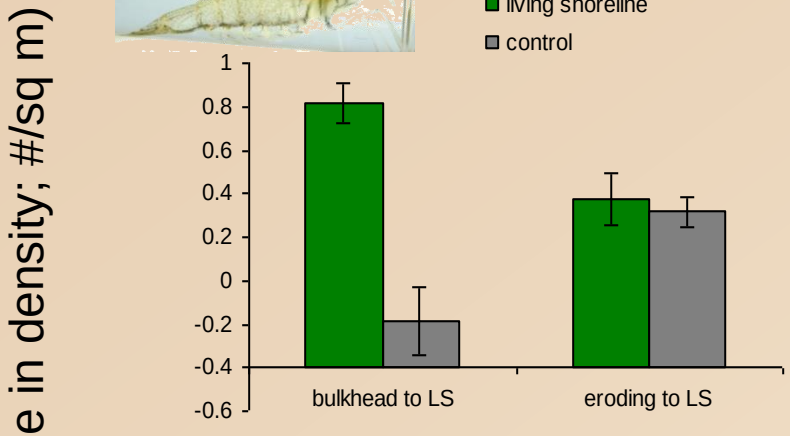
Ecological : Change in Spp. Diversity and Density hypothesized to be higher at LS sites than control sites

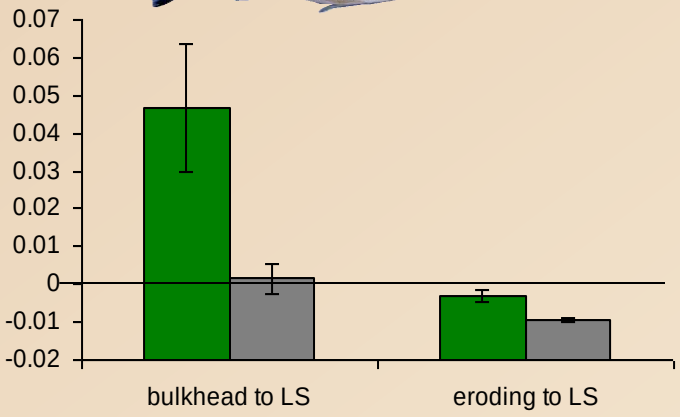
After-Before
(change in density;
#/sq m)

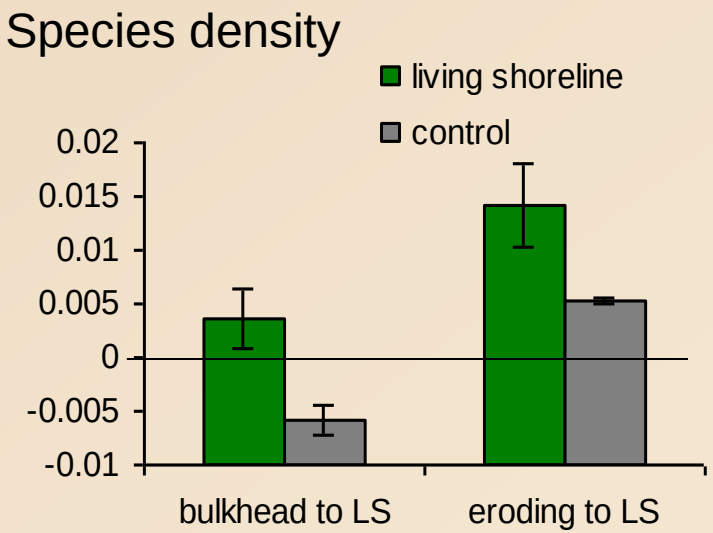


Ecological: Armor vs. Living Shoreline – Before and After

Several species increased at sites installed with living shorelines; none decreased







Physical/Erosion: Sill/Living shoreline sites have higher accretion than natural sites (Currin et al., 2010; NC)

LS

Marsh type	Marsh edge location	Net sediment accretion (mm y^{-1})	n
Natural	Lower	-6.92 A	4
Sill	Lower	5.36 B	4
Natural	Upper	1.18 A	4
Sill	Upper	4.73 B	4

Using "natural habitats" in armor in other systems (rocky intertidal): It's not all about wetlands

(Bulleri and Chapman, 2010; Italy)

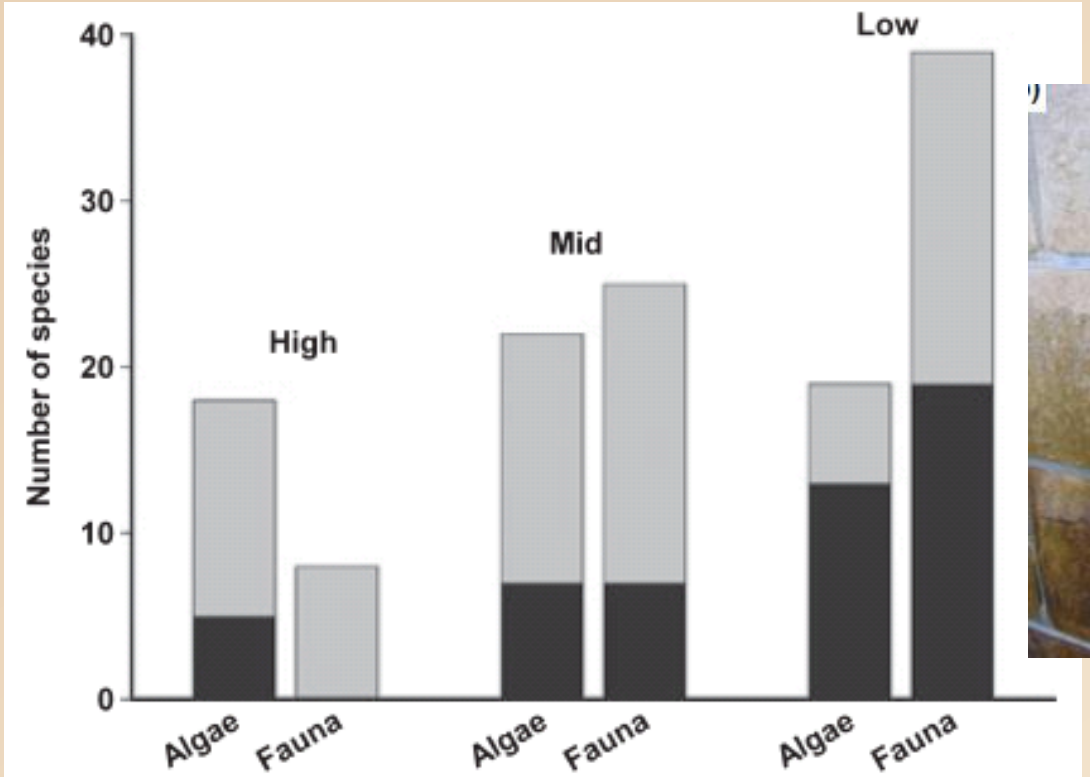


Fig. 2. The number of species of macro-algae and sessile animals living on the façade of the seawall (black bars) and the number of additional species found in the 'rock-pools' (clear bars) at three different shore levels (high, mid and low); data summed across all sites (see

Designing "rock pools' into seawalls

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- 2010 — VIMS evaluates engineering
- 2010 — President Obama's Ches. Bay Exec Order includes LS goal
- 2010 — Rhode Island and NJ begin discussing living shorelines
- 2013 — Second Chesapeake Living Shoreline Summit
- 2013-4 — Bay Program Expert Panel to grant NPS credit for LS projects

“Living Shorelines” – the solution for all ills

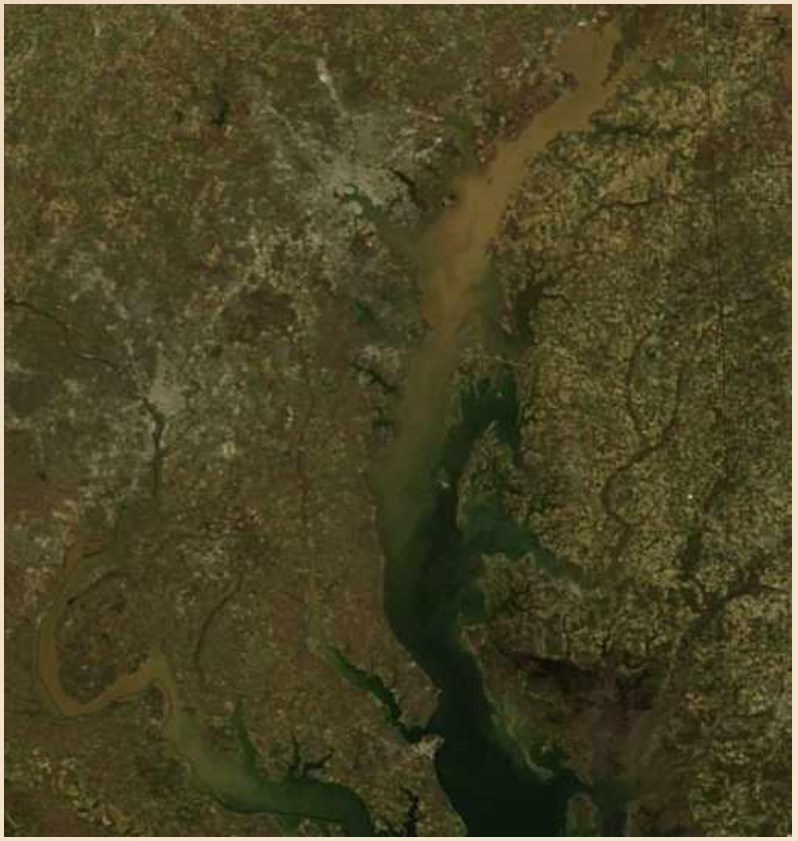
Connection to other issues: Climate Change and Bay Pollution

- 2008 MD Climate Action Plan - LS as climate change defense

- 2015 Bay Program gives LS N, P, and S credit –
  Expert Panel on Shoreline Management Practices

Sources of Sediment “Pollution?” in the Chesapeake

- **Watershed – Ag and SW**
- Oceanic Input
- Shoreline

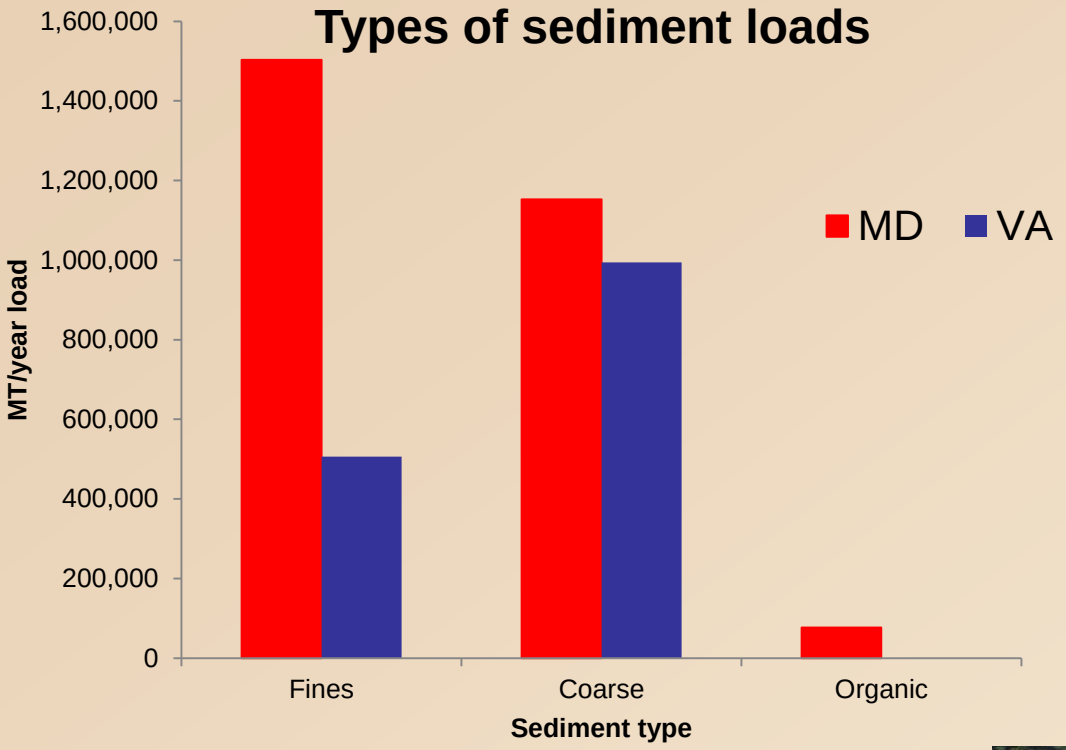


Sources of Sediment “Pollution?” in the Chesapeake

- Watershed– Ag and SW
- Oceanic Input
- **Shoreline**

We don’t know the percentage of erosion from boat wakes

Is sediment all bad?



Baltimore County Essex Skypark Example

2,610 linear feet

Before: erosion rate 1-1.5 ft/yr
bank height 4-7 ft

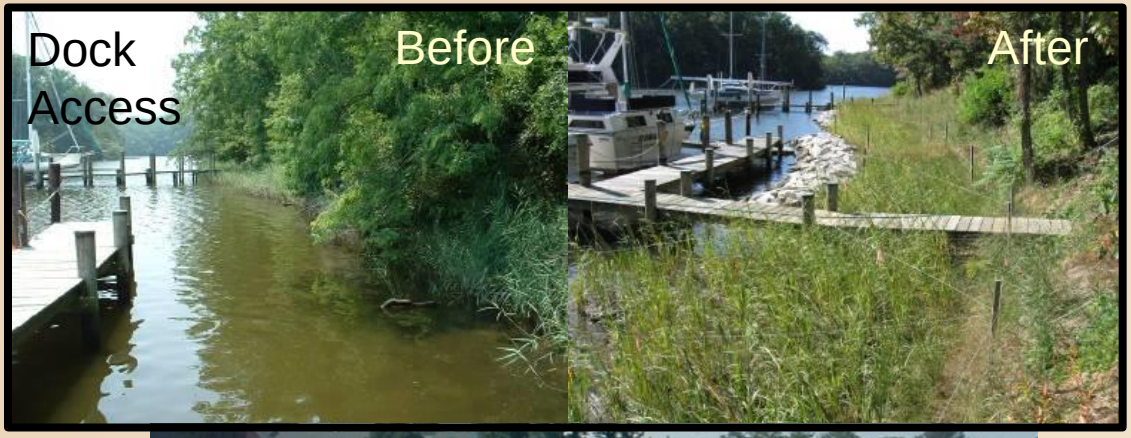
After: 1.8 acres vegetation

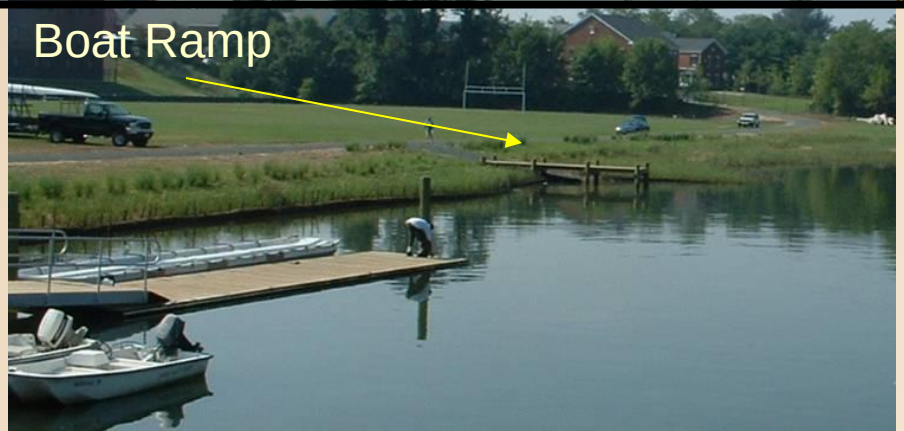
Total pollutant load:
- 462,596 lb TSS/yr

Engaging Landowners

- Demonstration Projects – Demonstrate Success

- Show Access/Consistent Uses





Funding

Living Shorelines – Cheaper than armor in low energy; more expensive at high energy. Who should pay?

- Grant Programs – Full funding or cost-share
- Local jurisdictions - MS4 credit incentives
- Property-owners support it themselves
  - Voluntarily - Property tax incentives
  - Regulatorily – E.g., MD's law

Top Unknowns

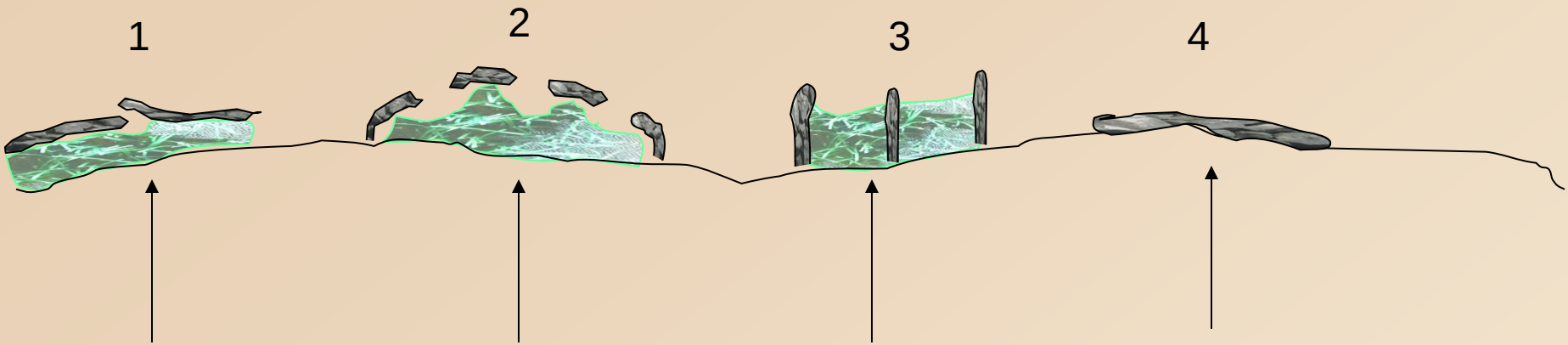
For scientists

1. Efficacy of LS (WQ, habitat, erosion)
2. Monitoring protocol development
3. Efficacy of types of LS and location
4. Adaptation to SL rise
5. Debate about where shorelines should not be protected from erosion

For regulators

1. Tradeoffs (subtidal, riparian buffer)
2. Efficacy of LS (WQ, habitat, erosion)
3. Cost benefit analysis and life cycle costs
4. How do we actually measure success
5. How do we prioritize LS sites basin-wide

Test Design Effectiveness for Erosion Protection and Habitat



1. LS #1
continuous sill
with windows

2. LS #2
segmented sill
(offshore breakwaters)

3. LS #3
groins

4. revetment

Lessons Learned

- Demonstration sites are key to provide a visual
- Need to demonstrate value during storm events
- Cannot promise a solution for all ills
- There will be those who say too green, and those who say not green enough